SDO FlatSat Facility

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SDO Overview

- **SDO – Solar Dynamics Observatory** *Website: http://sdo.gsfc.nasa.gov*

- **SDO's** goal is to understand and, ideally predict the solar variation that influence life and society by determining:

- How the Sun's magnetic field is generated and structured
- How this stored magnetic energy is converted and released into the heliosphere and geospace in the form of solar wind, energetic particles, and variations in the solar irradiance

- **SDO's** instruments will measure the properties of the Sun using the largest digital images ever flown by NASA. They will be taken high definition images of the Sun every few seconds, all day every day.

- **EUV Variability Experiment (EVE) –** PI Institution: University of Colorado

- ***Measures*** the solar extreme ultraviolet (EUV) special irradiance to understand variations on the timescales that influence Earth's climate and near Earth Space.

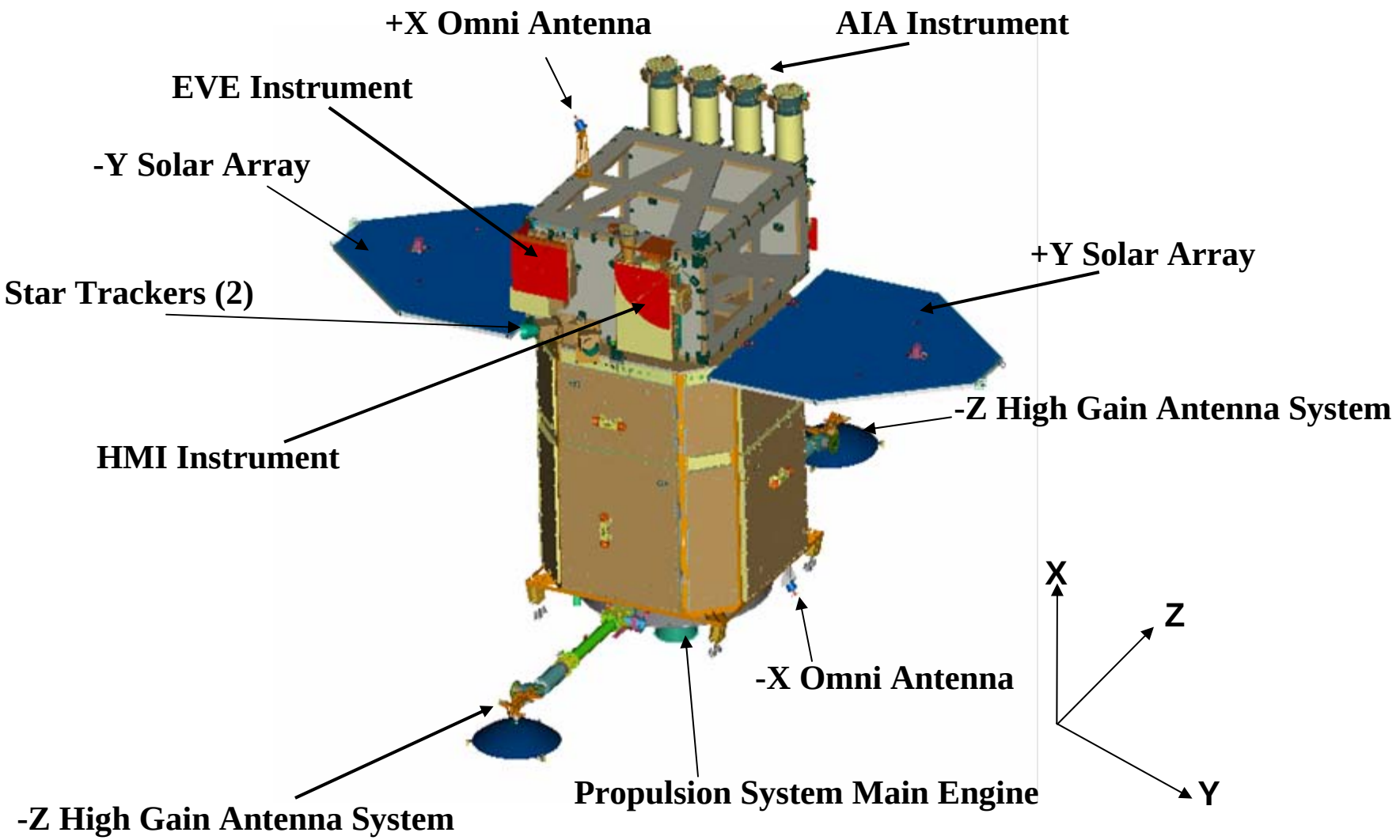
- **Helioseismic and Magnetic Imager (HMI)** – PI Institution: Stanford University

- ***Images*** the Sun's helioseismic, longitudinal, and vector magnetic fields to understand the Sun's interior and magnetic activity.

- **Atmospheric Imaging Assembly (AIA) –** PI Institution: Lockheed Martin Solar Astrophysics Laboratory

- ***Images*** the solar atmosphere in multiple wavelengths to link changes on the surface with interior changes.

SDO Observatory



What Is FlatSat? Why?

- FlatSat is a High Fidelity Electrical and Functional Representation of the S/C Bus
- FlatSat will Contain ETUs of the ACE, C&DH, GCE, and PSE each running Flight Software (FSW)
- FlatSat will contain “Flight Like” Electrical Interfaces and 1553/1335 Buses
- Various GSE will be used to Simulate other S/C Hardware and Interfaces
- FlatSat is a “High Fidelity” Test Bed for I&T, FSW, and Flight Operations
- FlatSat will be “Initially” Single String (PSE does contain some redundancy)
- FlatSat Provides Benefits to SDO S/C I&T
- FlatSat used by FSW for “High Fidelity” FSW Acceptance Testing
- FlatSat used by Flight Ops for “High Fidelity” Test Bed for Maintaining On-Orbit Flight Software
- No Flight H/W is Currently Planned to be Integrated into FlatSat, However this Option is not Precluded

FlatSat – Benefits To I&T

- Spacecraft Test Conductor Training Facility
- SGSE Operation and Verification
- FlatSat will be a “Driver” to Development and Dry Run Electrical Integration Procedures, STOL Test Procedures, Page Displays, and the Command and Telemetry Database, Learn S/C Operations All for I&T
- “Ringout” of I&T System, i.e. S/C Command and Telemetry Interfaces with SGSE Ground System, Flight Software, Flight Interfaces, and some Umbilical Functions
- FlatSat Utilizes SDO WOA/PR/PFR System which will be used during I&T
- Troubleshooting Facility

FlatSat – Benefits To Flight Software Development Team

- FlatSat Shall Serve as a Platform for Flight Software Acceptance and Systems Testing for the Flight Software System Components including:
  - the Spacecraft main Processor
  - the Power Supply Electronics (PSE)
  - the Attitude Control Electronics (ACE)
  - the Gimbal Control Electronics (GCE)
  - and the S-Band Communications Card

FlatSat – Benefits To Flight Operations Team

- Post Launch Flight Software Code and Table Update Development and Verification
  - TSM and RTS Updates
  - System Table Updates
  - Code Updates
- Verification of New/Updated Flight Operations Products
  - STOL Procedures
  - Telemetry Displays
  - RDL Command and Telemetry Databases
  - Operational Scripts/Processes For Orbit Raising to GEO, Normal Operations, and Contingency Operations
- Spacecraft Anomaly Investigation and Responses

Building A FlatSat (1/2)

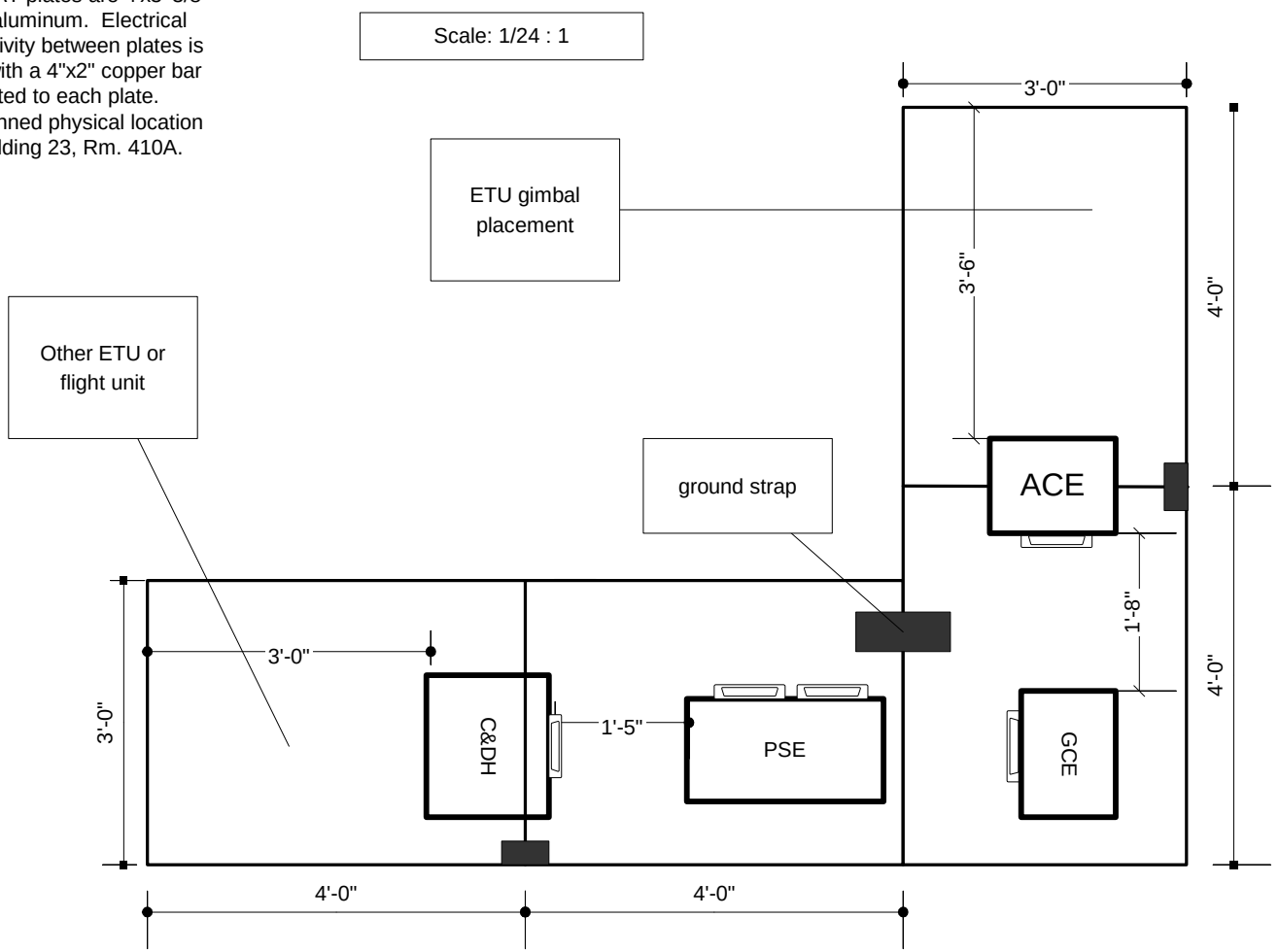
- Define Requirements/Purpose for FlatSat
- Define what H/W, ETU's, Simulators, Ground System Equipment is Available
  - Don't Forget Electrical Test Equipment
- Define what H/W Needs to be Built, Developed, and Purchase
- Define Roles and Responsibilities
  - Who is in Charge
  - Who Provides What, Who Performs What
- Define Facility And Facility Requirements and FlatSat Layout
  - Facility Location and Access Control
  - Facility AC Electrical Power Requirements (UPS Required?)
  - Facility Temperature and Humidity Control Requirements
  - Grounding
  - Facility Rules
- Define Operational and Logistical Requirements
  - Network Requirements
  - ESD Control Plan
  - Contamination Control
  - Dos and Don'ts
  - Documentation System (WOA & PR/PFR Systems)

Building A FlatSat (2/2)

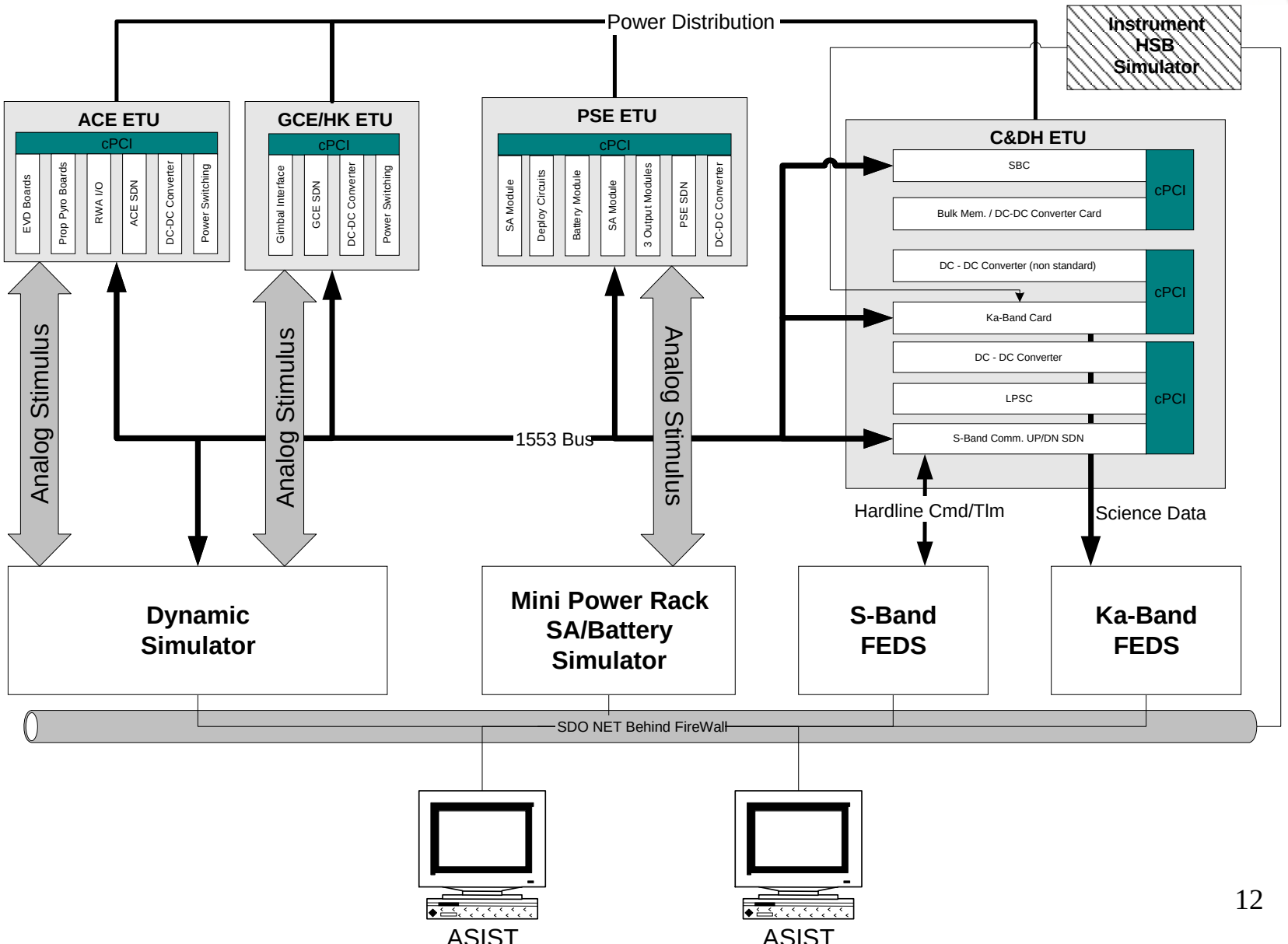
- Generate Build/Test Plan
  - Hardware Delivery /Build Up Plan/Order
  - Remember Provisions to Load/Upgrade the Flight Software
- Define Electrical Interfaces and Build Harness
  - Includes Interfaces Between ETU's, Simulators, Power Source
  - Keep in Mind Future Upgrades and/or Temporary Deliveries
- Develop Integration Process and Integration Procedures
  - Weight of ETU Boxes Maybe an Issue to Deal With
- Acquire Hardware And Perform Mechanical & Electrical Integrations of H/W
  - Hardware Bolted to Aluminum Plates With Electrical Bond Resistance <2.5 Milli-Ohms
- Perform Initial FlatSat Testing
- FlatSat is Now Functional
- Perform Future Hardware Upgrades

FlatSat – ETU Physical Layout

FLATSAT plates are 4'x3' 3/8 thick aluminum. Electrical connectivity between plates is made with a 4"x2" copper bar bolted to each plate.
The planned physical location is Building 23, Rm. 410A.



FlatSat – Functional Block Diagram



FlatSat – Photo #1

FlatSat – Photo #2

FlatSat – Summary

- SDO Observatory Overview
- What is FlatSat and Why Have One
- Benefits of Having a FlatSat
- How to Build a FlatSat
- FlatSat to be Treated as it is Flight:
  - Same ESD Precautions
  - Same Procedures, WOA, PR/PFR, CM Processes
  - Same Discipline
- FlatSat Facility Requirements, Access, Roles And Responsiblites
- ESD and CC Precautions
- FlatSat Mechanical and Electrical Integration, and Functional Testing
- FlatSat Responsibilities and CM
- FlatSat Facility Ready to Receive ETU's
- FlatSat - Much Value for the Money